L-4/T-1/ME Date : 06/07/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2011-2012

Sub : **ME 445** (Noise and Vibration)

Full Marks : 210 Time : 3 Hours

Symbols carry their usual meaning.

Reasonable assume any missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

The figures in the margin indicate full marks.

1. (a) Distinguish between mechanical vibration and sound. With sketches illustrate the fact that noise and mechanical vibration are mutually convertible. **(10)**

   (b) How is pipe noise attenuated in an HVAC system? Where and why is a sound trap used in an HVAC system? **(10)**

   (c) A point source uniformly radiates sound at a frequency of 1.5 kHz. At a distance of 7 m from the source SIL is 65 dB. Assume freely progressive sinusoidal wave and calculate: p_{rms}, I, X, and acoustic power. What is the value of directivity factor in this problem? Take $\rho c = 406$ rayls, $c = 344$ m/s. **(15)**

2. (a) Why is it difficult to control low frequency noise at its transmission path? List three devices to control low frequency noise. **(5)**

   (b) With neat sketches describe working principle of a silencer and an acoustic board. **(15)**

   (c) A reactive silencer has following particulars: noise frequency = 500 Hz, L = 0.08 m, $S_1 = 0.012\ m^2$, $S_2 = 0.24\ m^2$, c = 344 m/s. **(15)**

   Calculate: sound transmission loss through the silencer and corresponding coefficient of transmission.

3. (a) List the noise sources of a Diesel generator set. Describe briefly how such noise can be controlled. **(10)**

   (b) List different transducers used for noise measuring instruments. Briefly describe any two of them. **(12)**

   (c) An observer receives noise in terms of SPL from three engines as given ~~belw~~ below: **(13)**

   75 dB at a frequency 1 kHz from engine A

   85 dB at a frequency 1.2 kHz from engine B

   80 dB at a frequency 2 kHz from engine C

   Calculate: (i) resultant SPL when all three engines are on (ii) central frequency and octave number.

Contd P/2

ME 445

4. (a) What are the requirements of a good acoustic room? With necessary sketches describe the key points of machine foundation design in terms of noise and vibration control. **(15)**

   (b) With necessary sketches describe the standard practice to control vibrations and noise when a heavy duty machine with electrical conduits is to be installed. **(15)**

   (c) List five adverse effects of a noisy environment. **(5)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

The questions are of equal value.

5. (a) The mass m is attached to one end of a weightless stiff rod which is rigidly connected to the center of a homogeneous cylinder of radius r as shown in Fig. for Q. No. 5(a). If the cylinder rolls without slipping, what is the natural frequency of oscillation of the system?

   (b) A compressor of 50 kg mass is supported on spring and has an unbalanced rotating element of 8 kg m. When dampers having damping factor $\rho = 0.2$ are used, specify the stiffness of the supporting spring such that only 10% of the unbalanced force is transmitted to the floor. Also determine the magnitude of the transmitted force. The compressor is running at constant speed of 1200 rpm.

6. (a) Explain the working principle of Houdaille damper and with the help of curves explain the response of this damper.

   (b) The following information is given for a certain automobile shown in figure for Q. No. 6(b). Given: W = 1500 kg, k_1 = 3000 kg/m, k_2 = 3600 kg/m, l_1 = 1.3 m, l_2 = 1.8 m, radius of gyration about cg = 1.2 m. Determine the normal modes of vibration and locate the node for each mode.

7. (a) A generalized model for vibration measurement is shown in figure for Q. No. 7(a). The base is attached to the body having an unknown vibration A sin ωt. Find the motion of the system. Explain the effects of using soft spring and very hard spring for the above vibrometer.

   (b) Determine the first two natural frequencies of an oil-well drill pipe 1.5 km long, fixed at the upper end and terminating at the lower end to a drill collar 30 m long. The average outside diameter and inside diameter for drill pipe are 110 m and 90 mm respectively and those for drill collar are 190 mm and 50 mm respectively.

Contd P/3

ME 445

8. (a) For a SDOF system, having harmonically excited vibrations, following data is given: m = 150 kg, k = 2 MN/m, damping ratio = 0.5. Draw the system, mechanical impedance diagram, and write the governing equation. Find magnitude of the impressed force if X = 0.01 m at ω = 600 rpm. Also find the transmitted force. Draw TR versus β curve to show where vibration isolation is possible.

   (b) A simple beam has the following data:

   EI = 10^5 Nm^2, L = 5 m, self weight = 500 N/m, a point load of magnitude 300 N acts at mid-span. Use Dunkerlay's formula to calculate its natural frequency.

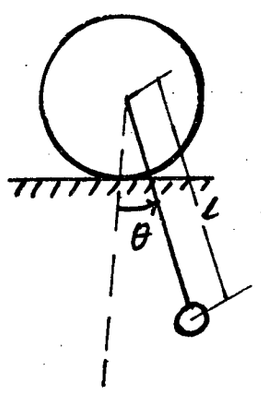

Fig. for Ques. No. 5(a)

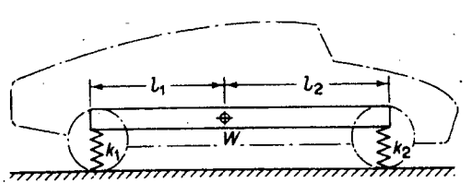

Fig. for Ques. No. 6(b)

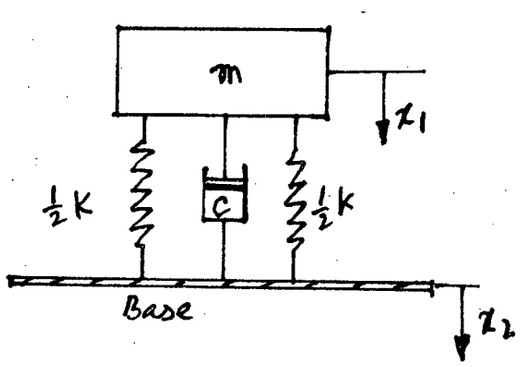

Fig. for Ques. No. 7(a)

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L-4/T-1/ME **Date : 06/07/2013**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2011-2012

Sub : **ME 461** (Control Engineering)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meaning.

Assume reasonable value for any missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Derive an expression for steady state error for a unity feedback system with a forward transfer function, G(s). **(10)**

   (b) Show that with a step input to a unity feedback system, the steady state error will have a non-zero finite value if there is no integration in the forward path. **(10)**

   (c) For a non-unity feedback system with $G(s) = 10\ (s + 10)/s(s + 2)$ and $H(s) = (s + 4)$, find the system type, the appropriate error constant associated with the system type, and the steady state error for a unit step input. **(15)**

2. Make an accurate plot of the root locus of a unity feedback system with **(35)**

   $G(s) = K(s+10)/s(s+1)(s+3)$

   Calibrate the gain, K for at least four points and find

   – The asymptotes

   – the breakaway point

   – the jω axis crossing point and

   – the range of K for stability

3. (a) For the unity feedback system of Q.2, find the value of K that yields a closed loop step response with 20% overshoot. Use root locus technique. List the assumptions, if there is any. **(20)**

   (b) The forward path transfer function of a unity feedback system is **(15)**

   $G(s) = K(s+2)/(s+3)(s^2+2s+2)$

   Find the angle of departure from the complex poles.

4. Draw the Bode plots for a unity feedback system with **(35)**

   $G(s) = K/(s+2)(s+4)(s+6)$

   (i) Find the range of K for stability

   (ii) Evaluate gain margin, phase margin, 0 dB frequency and 180° frequency for K = 200.

   (iii) What will be the value of K to make the gain margin = 10 dB?

Contd P/2

ME 461

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Functionally, how do closed-loop systems differ from open-loop systems? **(10)**

(b) Figure for Q. 5(b) shows a cutaway view of a commonly used pressure regulator. The desired pressure is set by turning a calibrated screw. This compresses the spring and sets up a force that opposes the upward motion of the diaphragm. The bottom side of the diaphragm is exposed to the water pressure that is to be controlled. Thus the motion of the diaphragm is an indication of the pressure difference between the desired and the actual pressures. It acts like a comparator. The valve is connected to the diaphragm and moves according to the pressure difference until it reaches a position in which the difference is zero. Sketch a block diagram showing the control system with the output pressure as the regulated variables. **(15)**

(c) Consider the system block diagram shown in Figure for Q. 5(c). With appropriate diagram show the contribution of Input Pole, System Zero, and System Pole on the system time response. **(10)**

6. (a) For the system shown in Figure for Q. 6(a) do the following, – **(20)**

(i) Find the transfer function $G(s)=\frac{X(s)}{F(s)}$

(ii) Find the system specifications for transient response subjected to a unit step input.

(b) By proper graphical representation, explain what will happen to the system response if **(9)**

(i) a pole is moved with a constant imaginary part,

(ii) a pole is moved with a constant real part,

(iii) a pole is moved along a radial line extending from the origin.

(c) Name the components of a block diagram for a linear, time-invariant system. **(6)**

7. (a) Reduce the block diagram shown in Figure for Q. 7(a) to a single block representing the transfer function $T(s)=\frac{C(s)}{R(s)}$. **(17)**

(b) Find the transfer function, $G(s)=\frac{X(s)}{E_a(s)}$, for the system shown in Figure for Q. 7(b). **(18)**

8. (a) A robot gripper, shown in Figure for Q. 8(a), is to be controlled so that it closes to an angle θ by using a DC motor control system, as shown in part (ii). The model of the control system is shown in part (iii), where, **(25)**

$k_m = 30$, $R_f = 1\ \Omega$, $K_f = K_i = 1$, $J = 0.1$, and $b = 1$

(i) Determine the response, $\theta(t)$ of the system to a step change in $\theta_d(t)$ when $K = 20$.

(ii) Assuming $\theta_d(t) = 0$, find the effect of a load disturbance $T_d(s)=\frac{A}{s}$ with $A = 1$.

(iii) Determine the steady-state error, e_{ss}, when the input is $r(t) = t$, $t > 0$. (Assume that $T_d = 0$).

(b) For a simple, second-order feedback control system of the type shown in Figure for Q. 8(b), describe the effect that variations of forward path gain K have on the transient response. **(10)**

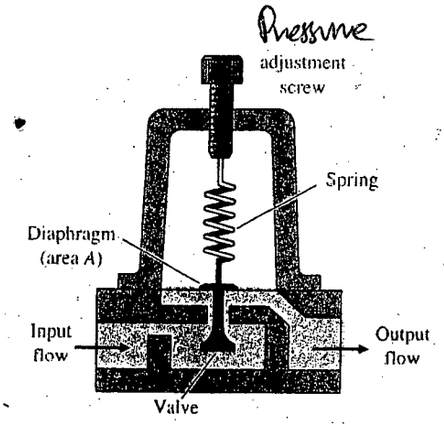


Figure for Q. 5(b)

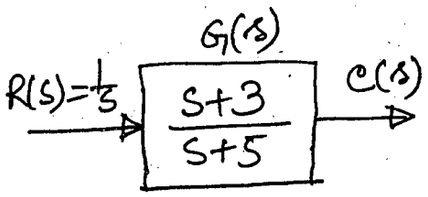


Figure for Q. 5(c)

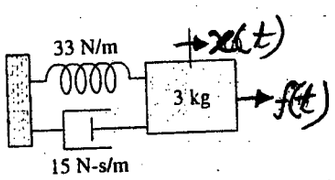


Figure for Q. 6(a)

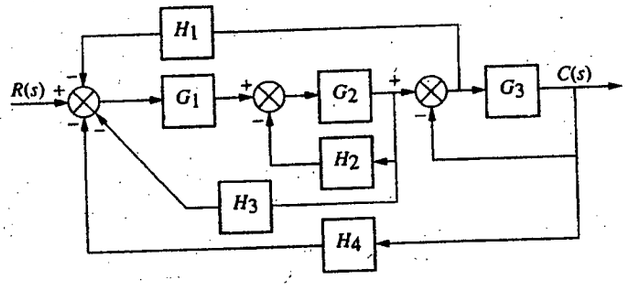


Figure for Q. 7(a)

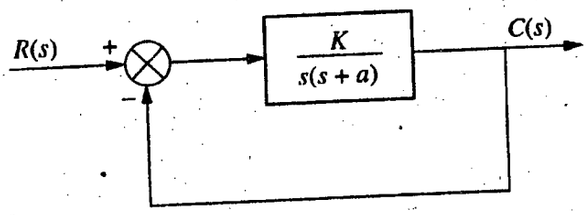


Figure for Q. 8(b)

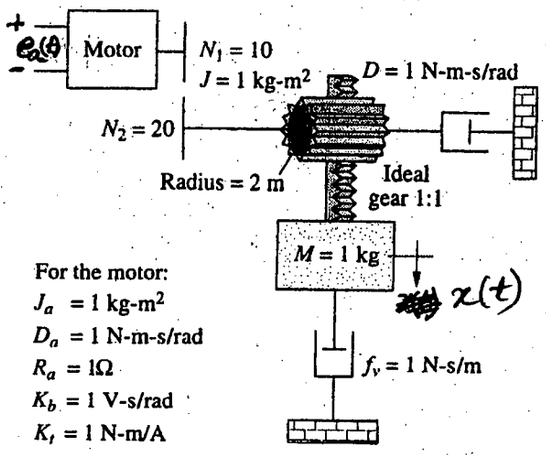
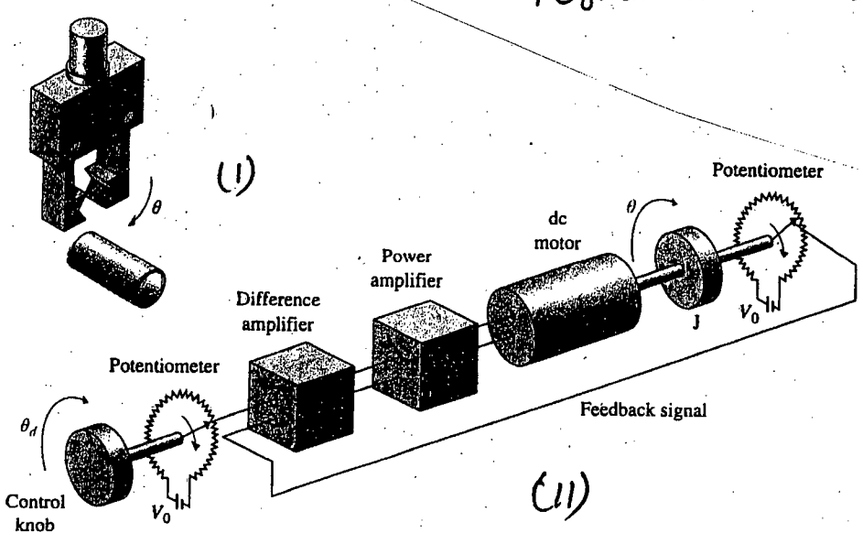


Figure for Q. 7(b)



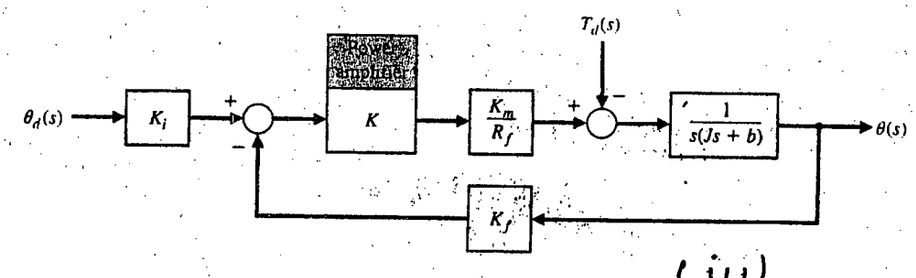


Figure for Q. 8(a)

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L-4/T-1/ME Date : 06/07/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2011-2012

Sub : **ME 467** (Automobile Engineering)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Assume reasonable values for missing data, if any.

1. (a) With the help of block diagrams show how power flows from the engines to the drive-wheels of cars with manual transmission in cases of: (i) FR layout (ii) FF layout and (iii) 4×4 layout.

   What are the component(s) that are to be changed for automatic transmission? **(16)**

   (b) What problems do occur to the propeller-shaft of a FR vehicles as the drive-wheels and holes? What are done to overcome these problems? **(7)**

   (c) With a neat sketch describe the construction and functions of an open-type differential. **(12)**

2. (a) Mention some differences between a clutch and a torque converter based on their construction, use and working principle. **(9)**

   (b) Explain in detail how a synchronizer works inside a manual transmission gearbox. **(12)**

   (c) With a neat diagram show the construction of a simple planetary gearset and explain how different speeds are achieved using this gearset such as increasing speed, decreasing speed, reverse speed, overdrive, etc. Why is an overdrive used? **(14)**

3. (a) Answer the following short questions (**any seven**): **(4×7=28)**

   (i) What do ABS and TCS stand for? Why are they used?

   (ii) What are the major advantages of disc brakes over drum brakes?

   (iii) What is camber? Why is it important?

   (iv) Why is a shock absorber used in the suspension system of a car?

   (v) What is McPherson strut? Why is it used?

   (vi) What are the major differences between bias-ply and radial-ply tires?

   (vii) What are the major components of the air-conditioning system of a car? How is the compressor driven?

   (viii) Why is tire rotation done? Show a 5-tire rotation pattern for FR vehicle.

   (ix) What is a limited-slip type differential? Why is it used?

   (b) Draw the typical graph for power required to overcome tractive resistance vs. power available at road wheels for a car. **(7)**

Contd P/2

ME 467

4. Determine the power required at the driving wheels to drive a car weighing 1.5 tons up a gradient of 8° at a uniform speed of 72 km/h. The air drag resistance is given as $0.08v^2$, where v is the speed of the car in km/h and the rolling resistance is 250 N/ton of the car weight. **(35)**

   If the same car has an axle ratio of 4 with an overall transmission efficiency of 90% and transmission gear ratio is set at 6 in the lowest (first) forward gear and the tyre diameter is 25 inch, determine the engine power required to climb up the slope.

   If the car is to accelerate uniformly from 20 km/h to 90 km/h in 5 seconds on a straight level road, determine the wheel power required.

   If the car has its CG at a height of 0.7 m above the ground and a track width of 1.3 m, calculate the overturning/toppling speed of the car during turn at 100 m radius.

   [Make necessary assumptions]

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) "Almost all automotive engines are multi-cylinder engines" – explain. **(6)**

   (b) What type of bearing are generally used with the automotive crankshaft? How are they lubricated? **(10)**

   (c) Explain, with neat sketches, how expansion is controlled in pistons. **(13)**

   (d) Give the firing-order of an in-line six-cylinder automotive engine, and list the piston pairs that travel together. Explain briefly. **(6)**

6. (a) What is tappet? Describe the construction and operation of a hydraulic tappet with neat sketches. **(13)**

   (b) What are the functions of the following carburettor components: (i) main-metering jet, (ii) choke valve, (iii) idle-adjustment screw, and (iv) accelerating pump? **(8)**

   (c) "Gasohol (ethanol blended with gasoline) should provide better performance than straight-run gasoline in respect of thermal efficiency and environmental considerations" – explain. **(5)**

   (d) Explain the differences between fixed-venturi and variable-venturi carburettors. **(5)**

   (e) List the various types of fuel-injection systems employed in modern automotive engines. **(4)**

Contd P/3

ME 467

7. (a) Describe, with a schematic, the engine lubrication system. What is meant by dry-sump lubrication? **(13)**

   (b) Why is an expansion tank fitted with the radiator? Explain. **(5)**

   (c) Why is valve cooling necessary? Describe, with neat sketches, how exhaust valves are cooled. **(8)**

   (d) Define reserve-capacity and cold-cranking rate of automotive battery. **(3)**

   (e) Draw and briefly explain the relationship among specific gravity, open-circuit voltage (OCV), and the state of charge of a battery. **(6)**

8. (a) With circuit diagrams, describe the operations of the starting motor solenoid. **(13)**

   (b) What is the purpose of using the alternator in automobiles? Describe its operation with a circuit diagram. **(12)**

   (c) Describe, with a cut-away view, the construction of a spark plug. What are the differences between the spark plug used in CPI system and that in HEI system? **(10)**

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L-4/T-1/ME Date : 23/07/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2011-2012

Sub : **ME 401** (Internal Combustion Engines)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable values for missing data (if any). Symbols have their usual meanings.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Explain, why the usual order of thermal efficiencies is : CI engine (highest), SI engine Gas turbine. **(10)**

   (b) Define indicator diagram. How is the indicator diagram of a real engine traced? Compare the indicator diagrams of a real SI engine and that of an air-standard Otto cycle. Explain the reasons of difference between the two. **(15)**

   (c) What are the effects of the ratio of imep to the maximum cycle pressure, p_3, on the engine design? Discuss briefly using a graph of imep/p_3 versus the compression ratio. **(10)**

2. (a) What is a flame? How are they classified? **(6)**

   (b) Discuss the parameters that affect the flame propagation in an IC engine combustion. **(7)**

   (c) What is meant by abnormal combustion in SI engines? Briefly discuss the various types of abnormial combustion in SI engine and their effect on the engine. **(15)**

   (d) Explain the stages of combustion process occurring in a compression ignition engine. **(7)**

3. (a) Describe a characteristic direct-injection CI engine flame with a schematic. **(10)**

   (b) What is meant by 'diesel index' of CI engine fuel? **(5)**

   (c) The dry exhaust gas analysis from an engine burning a hydrocarbon diesel fuel is as follows: CO_2 0.121, O_2 0.037, atmospheric N_2 0.842. Determine the gravimetric composition of the fuel, the equivalence ratio of the fuel/air mixture, and the stoichiometric air/fuel ratio. **(20)**

4. (a) Describe the load and speed control method used with a jerk-pump system in CI engine fuel system. **(10)**

   (b) Explain the significance of volumetric efficiency of engines. How is the volumetric efficiency affected by fuel, engine design, and engine operating variables? **(10)**

   (c) "Supercharging is employed in IC engines even through it consumes engine power"- explain why. **(5)**

   (d) Write an explanatory note on 'similar engines' and 'the principle of similitude'. **(5)**

   (e) Draw the typical curves of thermal efficiency versus pressure ratio of gas turbine at various turbine inlet temperatures. **(5)**

Contd P/2

ME 401

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Name five different view-points of classifying the internal combustion engines and introduce the associated classes. **(10)**

   (b) How the speed and load is controlled in an SI engine? Explain with proper sketching. **(10)**

   (c) A two-stroke CI engine delivers 5000 kW while using 1000 kW to overcome friction losses. It consumes 2300 kg of fuel per hour at an air-fuel ratio of 20 to 1. The heating value of fuel is 42000 kJ/kg. Find the (i) indicated power, (ii) mechanical efficiency, (iii) air consumption per hr, (v) indicated thermal efficiency, and (v) brake thermal efficiency. **(15)**

6. (a) What are the requirements of an ideal Gasoline? **(10)**

   (b) Explain what is meant by a cetane rating of 60 and an octane rating of 85. **(10)**

   (c) Distinguish between straight-run and cracked fuels. **(5)**

   (d) Explain why the ASTM and EAD equipment are not equivalent to engine conditions. **(10)**

7. (a) With the help of neat sketches, explain the pollutant formation mechanism in a diesel engine. **(15)**

   (b) With necessary diagram, discuss different types of catalytic converter and their limitations, used for exhaust treatment in SI engine. **(20)**

8. (a) Describe with a neat sketch construction and working principle of a common rail system of a Diesel engine. **(15)**

   (b) Describe with sketches the working mechanism of various CI nozzles. ~~(55)~~ 15

   (c) What are the objectives for designing the intake manifold in SI engines? **(5)**

L-4/T-1/ME Date : 21/09/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2011-2012

Sub : **ME 421** (Fluid Machinery)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

Assume reasonable values for missing data.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

The figures in the margin indicate full marks.

1. (a) What are the functions of centrifugal pump casing? Differentiate among the different types of casing. **(10)**

   (b) What is meant by starting speed of a centrifugal pump? Derive an expression for the minimum starting speed of a centrifugal pump. **(10)**

   (c) A centrifugal pump delivers 115 litr/s of water against a head of 40 m. The constant velocity of flow is 2.5 m/s and the pump runs at 550 rpm. The blade angles at the ilet and outlet are 15^0 and 45^0, respectively. Find the outside diameter of impeller and the widths of the impeller at the outlet and inlet. Assume that water enters the impeller radially at inlet. **(15)**

2. (a) Derive an expression for calculating NPSH and explain its effects on Cavitation. **(10)**

   (b) Give a brief description on matching of centrifugal pump to system characteristics. **(8)**

   (c) A two stages centrifugal pump is required for a fire engine for a duty of 70 litr/s at a head of 80 m. If the overall efficiency is 75% and specific speed per stage is 40, find (i) running speed, (ii) the power to drive the engine. If the actual manometric head developed is 65% of the theoretical head, the outlet angle of the blades 30^0, and radial flow velocity at exit 0.15 times the tipped speed at exit, find the outer diameter of the impeller. **(17)**

3. (a) Explain and compare the performance characteristics of hydraulic coupling and torque converter with necessary diagrams. **(12)**

   (b) What is similarity law? Discuss its use for pumps. **(8)**

   (c) To predict the performance of a large centrifugal pump, its model was made with the following specification: power = 24 hp, head = 8 m, speed = 925 rpm. Diameter of model pump impeller was 9 times smaller than that of the prototype. The prototype pump has to work against a head of 40 m. Find the speed and hp required to drive the prototype. Also determine the flow rate of both the pumps. **(15)**

4. (a) What is air vessel? Explain its function as well as savings the frictional loss for a single acting reciprocating pump. **(15)**

Contd P/2

ME 421

(b) The bore and stroke of a double acting reciprocating pump are 250 mm and 300 mm, respectively. The suction pipe is 20 m long while the delivery pipe is 100 m long. The pump draws water from a sump of 3 m below from the pump axis and delivers to a height of 80 m. The pump runs at 60 strokes per minute. The diameter of suction and delivery pipe is 100 mm and a large air vessel is fitted in the delivery pipe 4 m from pump cylinder. The pump is driven by a motor of 85% efficiency. Find the power required to drive the pump. Assume friction coefficient of the pipe is 0.05. **(20)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.
The questions are of equal value.

5. (a) What is specific speed of a turbine? Explain and derive the expressions for unit speed, unit power and unit discharge.
(b) A Pelton Wheel develops 7000 kW at 200 rpm working under a head of 225 m with an overall efficiency of 82%. Determine unit speed, unit discharge and unit power. Find the speed, discharge and power when the turbine is working under a head of 142 m.

6. (a) Why is the bottom portion of the bucket of a Pelton wheel cut? Find a relation between the speed of the jet and the speed of the wheel of a Pelton wheel considering maximum efficiency.
(b) A Pelton wheel is working under a head of 250 m developing 1000 kW at 300 rpm. The overall efficiency of the turbine is 85% and the coefficient of the nozzle is 0.98. If the velocity ratio is 0.46, find (i) diameter of wheel and diameter of jet; (ii) size of bucket and number of buckets.

7. (a) What kind of turbine is a Francis turbine? Find an expression of hydraulic efficiency of a Francis turbine.
(b) A Francis turbine develops 500 kW at 500 rpm under a head of 50 m. the hydraulic efficiency is 95% and the overall efficiency is 85%. The flow ratio is 0.20 and ratio of width to diameter is 0.15. The blades occupy 5% of the outlet area and the inside diameter is half of the outside diameter. Find the guide blade angle at inlet, blade angles at inlet and outlet. The velocity of flow at inlet and outlet is equal.

8. (a) If a jet strike, a series of flat moving vanes mounted on the circumference of a wheel, find the maximum efficiency of the wheel. The wheel is capable of moving around an axis.
(b) A Kaplan turbine develops 33000 kW under a head of 40 m. The speed ratio is 2.1 and the flow ratio is 0.62. The ratio of the diameter of boss and the runner is 0.36. If the overall efficiency of the turbine is 90%, calculate the runner diameter, speed and specific speed of the turbine.

L-4/T-1/ME Date : 28/09/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2011-2012

Sub : **IPE 431** (Machine Tools)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) What are the main specifications of an engine lathe machine? Give typical values for each of them. **(15)**

   (b) Kinematic diagram of an engine lathe machine is shown in Fig. for Q. 1(b). Derive and explain kinematic balance equation for: **(20)**

   (i) Spindle rotation

   (ii) Cutting metric threads and inch threads.

2. (a) Briefly explain different tapered turning methods with necessary sketches. **(15)**

   (b) Classify turret lathes. Briefly explain different advantages and disadvantages of a turret lathe. With neat sketches explain mechanism of collet chucks used in turret lathe. **(20)**

3. (a) Explain movements in a knee and column type universal milling machine. Kinematic diagram of a milling machine is shown in fig. for Q. 3(a). Derive kinematic balance equations of each movement. **(20)**

   (b) Briefly discuss procedures for making helical groves using a milling machine. Provide required kinematic diagram for setting of dividing head. **(15)**

4. (a) With neat sketches show different work piece-grinding wheel settings. Kinematic diagram of a cylindrical grinder is shown in Fig. for Q. 4(a). Briefly explain different movement based on this diagram. **(20)**

   (b) Differentiate form cutting and generating methods for gear cutting. Explain how setting for spur gear and helical gear differs in case of a gear shaper machine. Briefly discuss about circular-feed movement cutter and gear blank rotation. Use kinematic diagram shown in fig. for Q. 4(b). **(15)**

Contd P/2

IPE 431

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What are the significances of Ray diagram? For a GP-series show that $Z = 1 + \frac{\ln R_n}{\ln \phi}$. **(7)**

   (b) Show that the maximum relative loss of cutting speed, formative capacity, production volume are constant for a certain machine, which is following GP-series. **(11)**

   (c) Write down the kinematic advantages of GP-series. **(10)**

   (d) With necessary sketches, explain how tumbler gear works. **(7)**

6. (a) With necessary sketch, derive an equation for the transmission ratio of Wuelfel Kopp Tourator. **(10)**

   (b) What are the advantages and disadvantages of hydraulic drive? **(9)**

   (c) Explain the working principle of Vane pump with necessary figures. **(12)**

   (d) Why rough running occurs in gear pump? How this problem can be solved? **(4)**

7. (a) With necessary sketches, explain how hydro-static slideways work. Also mention some of its advantages. **(7+3=10)**

   (b) For a combination of vee and flat slideways, derive an expression of forces acting perpendicular to the surfaces of the slideways. **(15)**

   (c) Explain how pneumatic slideways works. What are the drawbacks of anti-friction slideways? **(7+3=10)**

8. (a) Explain travel control through a dropping worm with necessary sketches. **(11)**

   (b) What is locator? Explain Solid, Adjustable and Equalizing supports with necessary figures. **(7)**

   (c) Discuss different types of foundations used for installing machine tools with necessary sketches. Also give examples of different situations and methods for securing machine tools to the foundation for the following machines **(17)**

   (i) Knee type milling machine

   (ii) Engine lathe

   (iii) Radial drills

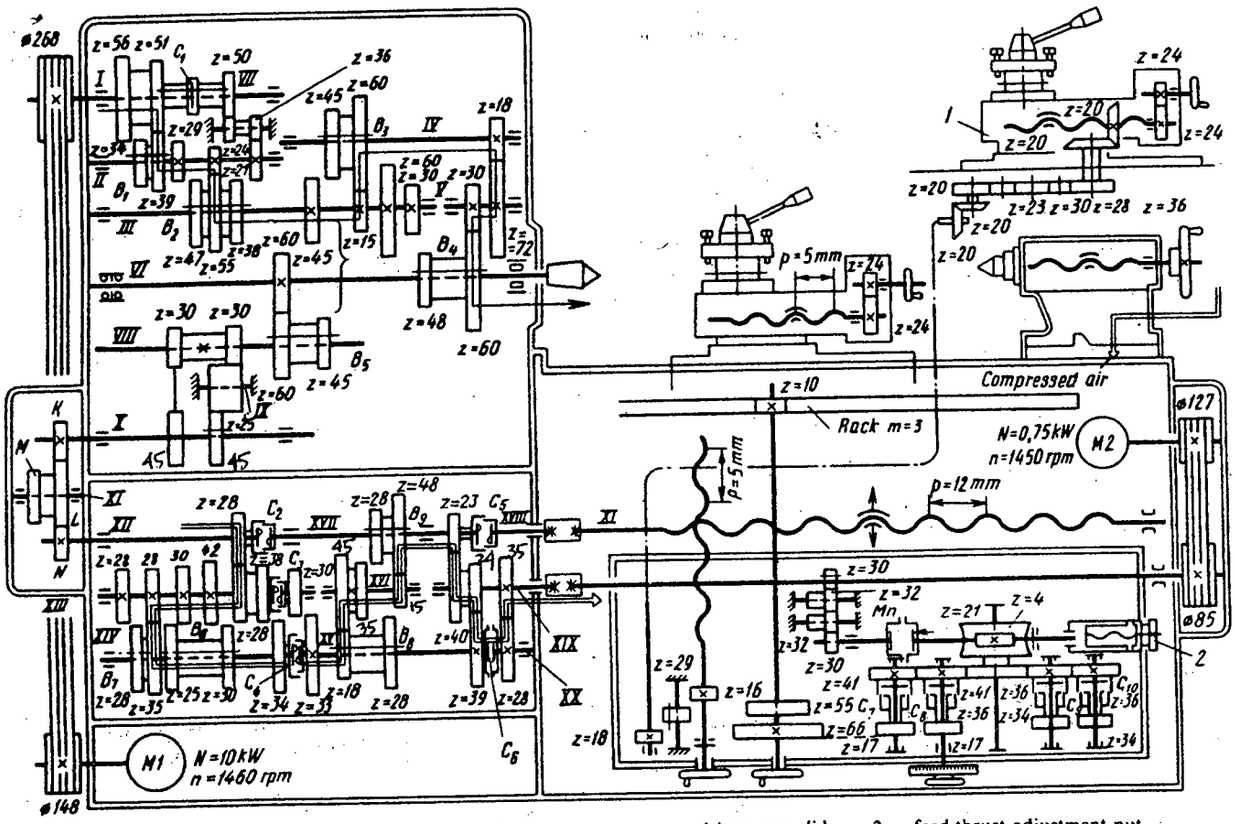

Fig. 66. Kinematic diagram of model 16K20 engine lathe: *1* — power-driven top slide; *2* — feed-thrust adjustment nut

Fig. for Q.1(b)

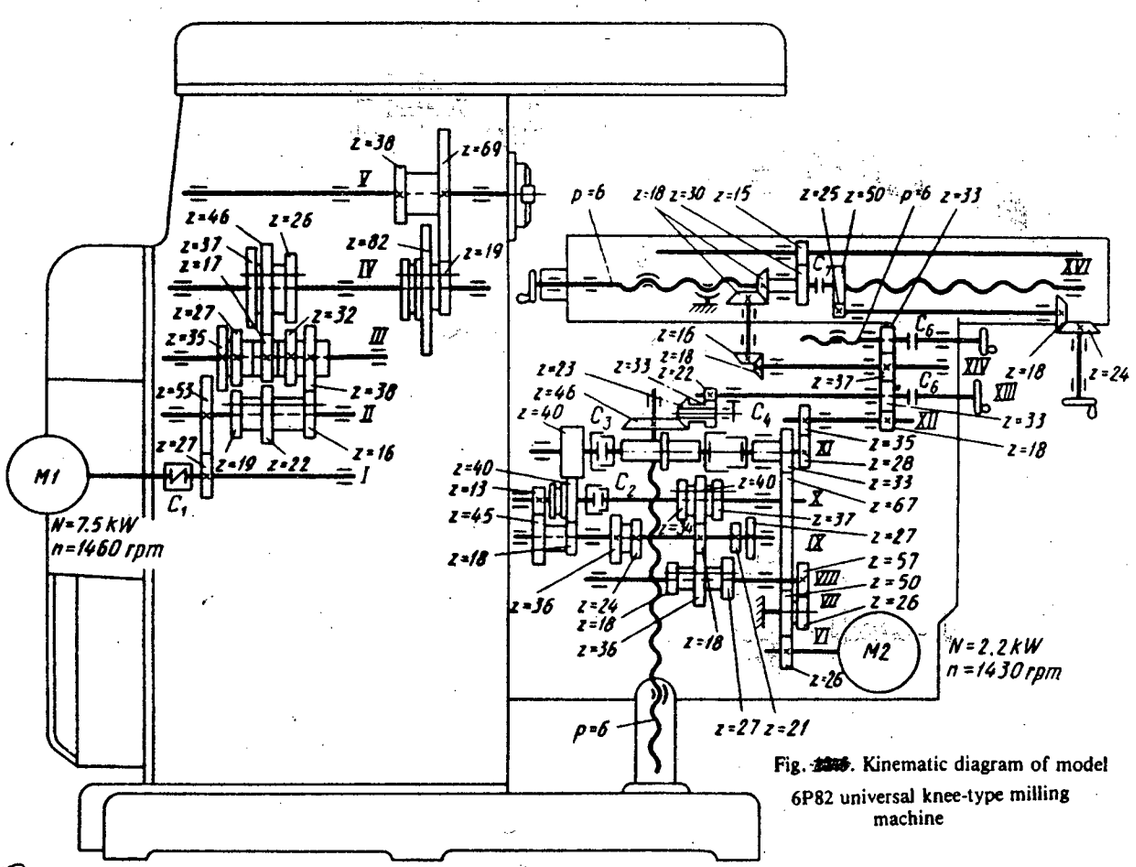

Fig. 67. Kinematic diagram of model 6P82 universal knee-type milling machine

Fig.

Fig for Q.3(a)

IPE 431 =7=

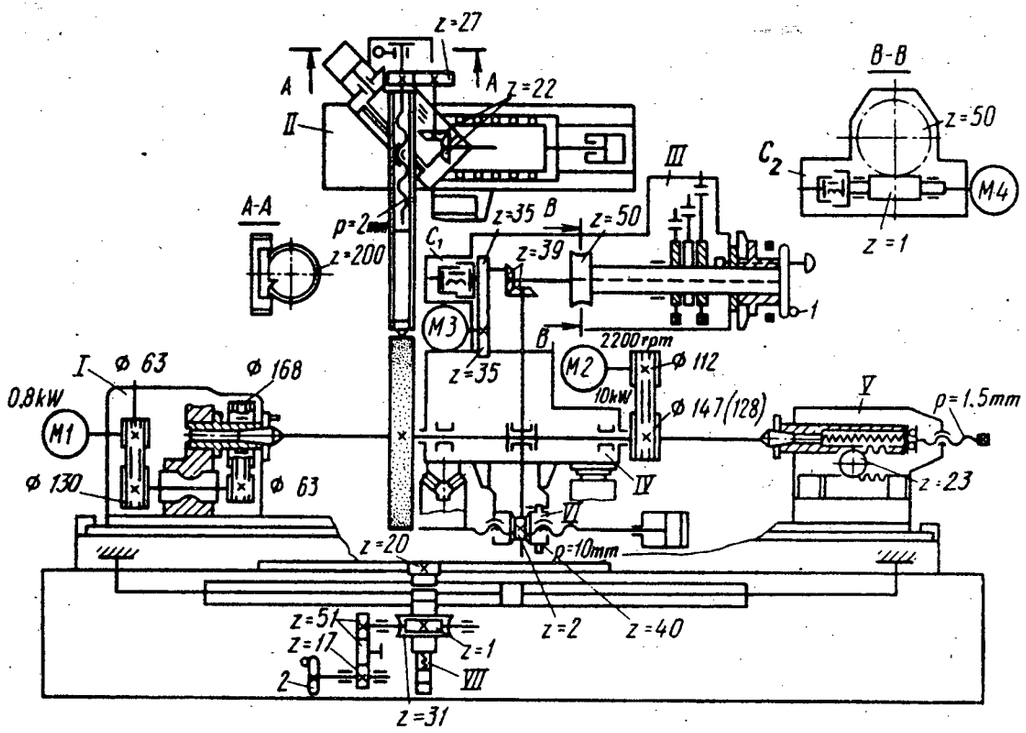

Fig. 1.2. Kinematic diagram of cylindrical grinding machine, model 3M51: *I* — workhead; *II* — wheel dresser; *III* — feed mechanism; *IV* — wheelhead; *V* — tailstock; *VI* — rapid-approach mechanism; *VII* — hand-operated table-traverse mechanism

Fig. for Q.4(a)

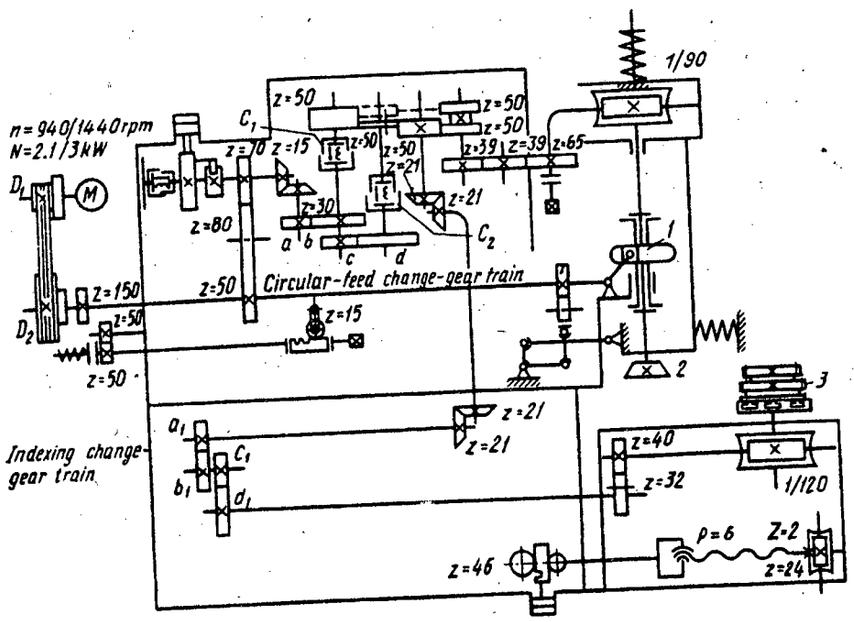

Fig. 1.4. Kinematic diagram of the model 5122 gear-shaping machine

Fig. for Q. 4(b)

L-4/T-1/ME **Date : 05/10/2013**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2011-2012

Sub : **ME 415** (Refrigeration and Building Mechanical Systems)

Full Marks : 210 Time : 3 Hours

Refrigeration and A/C Data book will be provided

The figures in the margin indicate full marks.

Assume any reasonable value, if required.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Estimate the cooling load of an office room at 3:00 PM for the following conditions:

Location	:	Dhaka
Date	:	21st April
Floor	:	10 m × 10m, height = 3.5 m
Roof	:	Type 4, 100 mm concrete with 75 mm insulation
Walls	:	Type G, metal curtain wall
Windows	:	25% of wall area, 13 mm clear glass, U = 2.5 W/m^2°C
Light	:	12 W/m^2, fluorescent bulb
People	:	3 person, doing office work
Equipment	:	3 computers @ 75 W

Assume, negligible heat transfer through floor, south and east walls.

Assume, ASHRAE standard outdoor design conditions and ventilation air supply. **(35)**

2. (a) Briefly explain the factors affecting human comfort. **(5)**

(b) With schematic diagram, briefly explain the key components of a central air-conditioning system. Mention the functions of following 4 components **(15)**

(i) chiller

(ii) cooling tower

(iii) AHU

(iv) FCU

(c) An air handling unit serves 3 rooms in an apartment, as shown in Fig. for Q. 2(c). **(15)**

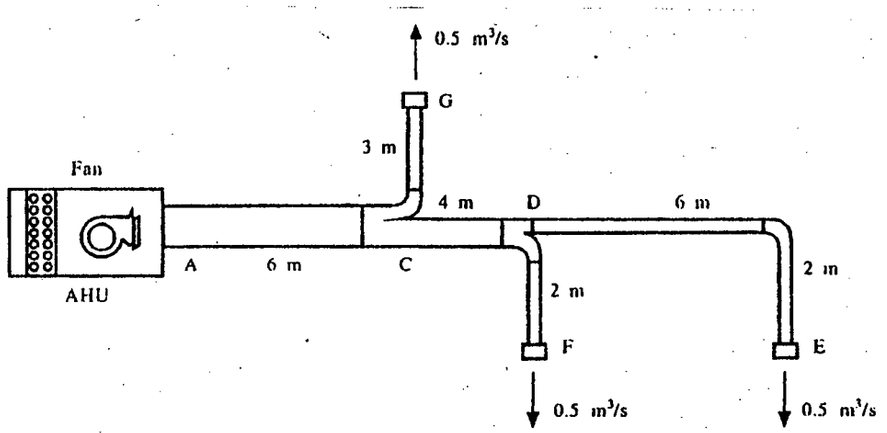

Fig. for Q. 2(c)

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ME 415

Contd ... Q. No. 2(c)

(i) Size the duct system using equal friction method. Assume maximum allowable air speed = 10 m/s.

(ii) Estimate the four pressure required if there is a pressure drop of 20 Pa at each of the outlet grils at E, F and G, and pressure losses due to joints are assumed to be $\frac{1}{4}$ of the duct pressure drop.

3. (a) Distinguish between split type and window type air conditioners. **(5)**

(b) Briefly explain, with schematic diagrams and processes on typical psychrometric charts, **(15)**

(i) Summer a/c system with bypass

(ii) Summer a/c system with reheat

(c) A space is to be maintained at 50% relative humidity and 24 °C. The space has a sensible heat gain of 20 kW and moisture gain of 10 kg/hr. Moist air enters the space at 16 °C. Outside air at 35 °C dbt and 27 °C wbt is supplied at a rate of 400 litre/s. considering the system use is an elementary summer A/C system, estimate **(15)**

(i) wbt and dbt of air entering the space.

(ii) required refrigeration load.

4. Write short notes on (any 5) **(35)**

(i) Hydraulic lift

(ii) Roping of traction lift

(iii) Safety devices used in conventional lifts

(iv) Modes of fire extinguishments

(v) Types of fire extinguishers

(vi) Fire extinguisher marking as per NFPA

(vii) Advantages of gearless lift drives

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Mention the advantages of vapor compression refrigeration system over air refrigeration system. **(5)**

(b) Explain the effects of superheating and subcooling in a refrigeration system. **(10)**

(c) In a 15 TR ammonia refrigeration plant, the condensing temperature is 25 °C and evaporating temperature –10 °C. The refrigerant ammonia is sub-cooled by 5 °C before passing through the throttle valve. The vapor leaving the evaporator is 0.97 dry. The specific heat of saturated ammonia liquid at 25° is 4.6 kJ/kgK and saturated ammonia vapor at 25 °C is 2.8 kJ/kgK. Find (i) the coefficient of performance, and (ii) Power required to run the plant. **(20)**

Contd P/3

ME 415

6. (a) Describe, with the help of schematic and p-h diagrams, the working of a two stage compression system with water intercooler, liquid intercooler and a liquid flash chamber. **(10)**

(b) The following data refer to a three stage compression with three stage expansion valve and flash intercooling: **(25)**

Condenser pressure = 12 bar

Evaporator pressure = 2 bar

Flash intercooler pressure = 4 bar and 8 bar

Load on the evaporator = 10 TR

Find the power required to drive the system and compare the C.O.P. of this system with that of simple saturation cycle working between the same overall pressure limits.

7. (a) What are the advantages and disadvantages of centrifugal compressor over reciprocating compressors? **(10)**

(b) Give the comparison of air-cooled condenser and water cooled condenser. **(10)**

(c) Explain in brief as to why capillary tube is preferred to other throttling devices in household refrigerator. **(5)**

(d) Discuss the frosting, non-frosting and defrosting evaporators. **(10)**

8. (a) Why is H_2O not used as a refrigerant in compression refrigeration system? (Although it is used as a refrigerant in absorption refrigeration). **(5)**

(b) What are the disadvantages of Lithium-bromide-water absorption system of refrigeration? **(5)**

(c) Discuss the desirable slopes of saturation curves (liquid and vapor) of a refrigerant. **(10)**

(d) In an absorption type refrigerator, the heat is supplied to NH_3 generator by condensing steam at 2 bar and 90% dry. The temperature in the evaporator is to be maintained at –5 °C. Find the maximum C.O.P. possible. If the refrigeration load is 20 tonnes and actual C.O.P. is 70% of the maximum C.O.P., find the mass of steam required per hour. Take temperature of the atmosphere as 30 °C. **(15)**
